

# Trace Mixing

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**Trace Mixing** performs various types of trace mixes. It does not mix across trace ensemble boundaries unless the data is poststack.

## Theory

The following five algorithms are currently supported.

**Weighted trace mix** multiplies the horizontal trace samples within the trace mixing window by the given weights, sums the weighted samples, and normalizes this accumulated weighted sample sum by the sum of the weights.

**Median mix** sorts the samples within the trace mixing window and passes the median sample of the sorted array.

**Weighted median mix** sorts the samples within the trace mix window, along with their weights. When the weights of the ordered sequence total greater than one-half the sum of the mix weights, this point is selected as the weighted median and is passed as the mixed sample value.

**Alpha-trimmed mean mix** sorts the samples within the trace mix window. A range of values centered about the median are then averaged and passed as the mixed sample value. Equivalently, this process discards outlying points but smooths the interior points. If a 40% rejection percentage is used, with a three sample weight of (1, 1, 1) that is, equal weighting, the smallest sample would contribute:

$$(1.0)(1.0 - 0.2)(\textit{SmallestSample}) = (0.8)(\textit{SmallestSample})$$

the middle sample would contribute:

$$(1.0)(1.0 - 0.0)(\textit{MiddleSample}) = (1.0)(\textit{MiddleSample})$$

and the largest sample would contribute:

$$(1.0)(1.0 - 0.2)(\textit{LargestSample}) = (0.8)(\textit{LargestSample})$$

Then the output sample becomes:

$$\textit{Output} = \frac{(0.8)\textit{SmallestSample} + 1(1.0)\textit{MiddleSample} + (0.8)\textit{LargestSample}}{0.8 + 1.0 + 0.8}$$

A 30% rejection percentage for a simple, unweighted, alpha-trimmed mean would have no effect, since 15% of three samples is less than one sample. A 40% rejection percentage for a simple, unweighted, alpha-trimmed mean would result in two of the three samples being rejected since 20% of three samples rounds up from 0.6 to 1 sample.

**Weighted alpha-trimmed mean mix** sorts the samples within the seismic trace mix window, along with their weights. Assuming a rejection percentage of 40%, the weights in the ordered sequence are summed until one sample's weight exceeds 20% of the cumulative weight of the whole mix. A fraction of this sample is included in a weighted average, based on the exact position of the 20% weight sum. If the 20% weight sum mark was passed precisely as the sample was added, the sample is multiplied by its weight, and accumulated with the sum of other weighted samples. If the 20% weight sum mark was reached only when the total weight of the sample was added, the sample will not contribute to the weighted alpha-trimmed mean. If the weight sum was at 15% prior to adding the sample, and at 25% after adding the sample, then the sample, multiplied by half its weight, is accumulated in the sum of the other weighted samples. Similarly, half of the sample's weight is accumulated in the sum of weights. A similar method is used to determine when the last sample to be included is encountered, with a similar proportional contribution. Finally, the accumulated weighted sample sum is normalized by the total sum of the accumulated weights and passed as the output of the trace mix.

## Usage

A simple trace mix can be obtained by using the weighted trace mix algorithm, with all weights set to 1.0.

Five trace mixing algorithms are available because conventional trace mixes are adequate for well-behaved seismic data; the median and the alpha-trimmed mean algorithms have the significant advantage of rejecting any spurious samples with unusually large positive or negative sample amplitudes. A conventional trace mix does not have this property. In addition, two modes for mix application are provided. The first mode simply passes the computed sample value. The second mode subtracts the computed sample value from the input sample at the center of the mix. All of

the mixing routines provided can be used in the subtraction mode to attenuate certain linear noise trains, such as first break energy or coherent linear noise on stacked sections. In this application, you can use the velocity parameter to specify the velocity of the noise which you wish to filter. The velocity you specify should be the same as that which is measured on a **Screen Display**. When attempting to filter out coherent noise, it is strongly recommended that this process be used in conjunction with **Windowed Processing**, found on the menu under the **Miscellaneous** category, in order to avoid affecting seismic data outside the noise-contaminated data window.

If you are processing VSP data you will also find these tools very effective for separating up-going from down-going energy.

Please note that any remaining fractional sample static is automatically applied prior to the application of the trace mixing process. This application ensures the removal of the chatter caused by any remaining fractional sample static, prior to spatially filtering the data.

**Caution:** Due to the nature of median filters, there are occasional discontinuities in sample values that result from shifts in the values of the populations of samples in the median process. It is strongly advised that any median filter be followed by a wide bandwidth filter, such as 0-1-150-250, to eliminate this computational artifact.

## References

Stewart, Robert R., 1985, Journal of the Canadian Society of Exploration Geophysicists, 21, No. 1, 54-63.

Haldorsen, Jakob B.U, and Farmer, Paul A., Suppression of high-energy noise using an alternative stacking procedure, 1989, Geophysics, 54, No. 2, 181-190.

## Parameters

### ***Trace mixing algorithm***

Select any one of the following five types of trace mixes:

- **Weighted trace mix**
- **Median mix**

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- **Weighted median mix**
- **Alpha-trimmed mean mix**
- **Weighted alpha-trimmed mean mix**

### ***Exclude hard zeros?***

This appears if **Weighted trace mix** to **Trace mixing algorithm**. Select **Yes** to recognize exact 0.0 values and eliminate these values from the computation, thereby computing correct weight normalization scalars. The disadvantage of this option is that it slows down the process by about 10%-20%.

### ***A-T mean rejection percent for mixing***

This appears if **Alpha-trimmed mean mix** or **Weighted Alpha-trimmed mean mix** to **Trace mixing algorithm**. Enter the percentage of the input samples to reject prior to averaging the remaining samples. A value of **40%** implies that the smallest **20%** of the samples and the largest **20%** of the samples will be thrown out for the trace mix computation. If a value of **0%** is entered, the trace mix will output the mean sum. A value of **100%** will result in a median trace mix.

### ***Trace weights for mixing***

This appears if a **Weighted option** to **Trace mixing algorithm**. Enter the trace weights in the text editor, or type a filename into the editor, followed by a Ctrl-r to read a precomputed file directly. The process automatically checks for the correct number of weights and that all of the weights are positive or zero.

### ***Number of traces to mix over***

Enter the number of traces to use for mixing the traces. This value must be an odd integer.

### ***Type of trace edge taper***

Select how the mix is computed at the very beginning and very end of a group of traces. The choices are:

- **Fold edge back** maintains a full operator at the edges by folding back half an operator width of traces. For five trace mix, trace 2 and trace 3 will be folded back around

trace 1. The resulting dataset will appear to the mix in the following order: trace 3, trace 2, trace 1, trace 2, trace 3, trace 4, and similarly at the other end. These folded back traces are used to fill out the mix and are not passed on in the flow.

- **Roll on / roll off** passes the first trace as is. The second trace will have a three trace mix applied using traces 1, 2, and 3, and the third and subsequent traces will be mixed by normal, five-trace operators. A similar 5, 3, 1 compression of the horizontal dimension of the mix will take place at the end of the ensemble of traces.

One of the above methods is recommended for applying edge tapers. However, a third option is available:

- **Zero trace pad** adds zero sample valued traces to the mix's input traces so every mix has the same number of traces. **Note:** This option has the effect of creating zero sample value traces for median mix for the first and last (number of mix traces/2) traces in the mixed output, or exactly reproducing the input traces if the **subtraction** mode is used.

### ***Application mode for mixed traces***

Select from:

- **Normal** passes the computed mixed sample. This is typically used for mix-like enhancement applications.
- **Subtraction** subtracts the computed, mixed sample from the input sample at the center trace of the trace mix. This is used when you wish to reject some type of coherent energy.

### ***Minimum number of traces for subtraction***

This appears if **Subtraction** to **Application mode for mixed**. Enter a minimum number of traces to include in the mix before the trace is subtracted from the input trace. This avoids the problem of the first and last traces in the ensemble being killed since the mix includes a single trace at the start and end. If fewer than this number of traces are in the mix, the original trace is passed unaltered. The default value is **3**, but you can set it to 5 or 7 for longer spatial mixes.

### ***Steer trace mix along a velocity dip?***

Select **Yes** to automatically flatten the seismic data, using a specified linear moveout velocity, prior to computing the mixed traces. The traces are always flattened relative to the trace at the center of the trace mix window, so there should be no noticeable time shift on the output data. Steering mixes along a velocity dip is commonly used in conjunction with **Subtraction** to remove a linear noise train. Typically, this process would be preceded by **Windowed Processing**, so that only the region of data contaminated by noise is affected by the mix.

### ***Linear moveout velocity for dip steering***

This appears if **Yes** to **Steer trace mix along a velocity dip**. Enter the linear moveout velocity. **Note:** The sign of these velocities is defined, since it differs for CDP stacked and unstacked data. For unstacked data, positive velocities are defined as those with increasing moveout as the Magnitude of the source- receiver offset increases. For CDP stacked data, positive velocities are defined as velocities whose moveout increase with increasing CDP bin number. If you aren't seeing the effect you expect from this tool, it is likely that your velocity has the wrong sign.

### ***Number of applications***

Enter the number of times to apply the filter. This allows you to specify a box car filter and cascade it many times to get the same effect as a Gaussian filter.

### ***Reapply mutes after mixing***

Select **Yes** to reapply previously applied mutes after mixing. For example, you may want to reapply first break mutes to eliminate mixed-in signal. Select **No**, the mutes will not be reapplied. You can use this option to remove the effects of a surgical mute, or use a trace mix to fill in a missing trace before migration.